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times in the centrosomes, and the chromosomes may appear rather as hollow vesicles than as solid bodies. The general protoplasm, filled with yolk, showed in some cases a very fine net-alveolar structure in places. On the surface the alveolar layer of Bütschli was always present, and just after the cleavage a very plain cell-plate of Carnoy is regarded and figured by the author as merely the appressed alveolar layers of the two adjacent cells.

PSYCHOLOGY.[1]

Physiological Effects of Mental Work.—Within the present decade the relation between mental work and the bodily processes has been the subject of much study. Interest in the problem as a field for practical inquiry was first aroused by a paper on the fatigue resulting from intellectual work, published by Sikorsky in the *Annales d'hygiène publique* for 1879. He was followed more than ten years later by Burgerstein, Laser, Griesbach and others. In these investigations the method used was that of testing school children in classes. Various problems and exercises were set before them, during and after the school session, and the percentage of errors committed in the operations was taken as measure of the fatigue due to mental work. While some individual errors might be due to other causes, the average percentage of the entire class seemed a fair test of this factor. The latest instances of this method are the investigations of Friedrich and Ebbinghaus described in the May number of the NATURALIST. At about the same time Mosso and his pupils took up the question from another side. They instituted a series of laboratory investigations upon single individuals by means of the ergograph, with a view to determining the fatigue due to steady intellectual, as well as physical work. Kraepelin and his pupils meanwhile undertook the same problem, varying it with tests of the influence of various stimulants and narcotics on the capacity for mental work. They made use of the reaction time method, as well as the percentage of errors. More recently, Binet and his pupils have taken up the subject from a different standpoint, their object being to measure the effect of mental stimulation and mental effort on the bodily processes of breathing, heart action, etc. Several other investigators have studied the problem in one or other of these forms, among them may be noted Féré, Patrick and Gilbert, Frey, Bolton, Bergström and Henri.

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[1] Edited by Howard C. Warren, Princeton University, Princeton, N. J.

In an article in the *Année psychologique* for 1896, M. Henri gives a résumé of the various investigations and the methods used in each. He emphasizes the importance of distinguishing the different factors involved in both mental and physical work, and of studying each one separately by appropriate experimental methods. Among these factors he specifies in particular attention, voluntary effort, the psychic processes of memory, and imagination. Little progress has as yet been made in the way of investigating effort except in the study of pathological cases such as aboulia. As for attention, while considerable work has been done in this field, the investigations have generally had for end to determine the mental effects of fatigue and other variations in the conditions, rather than to measure the *physical* effects of variations in the *attention*. Memory has been, perhaps, more systematically studied than any of the other factors.

The investigation of the effect of intellectual work on the pulse and other functions which MM. Binet and Courtier have undertaken seems most likely, of all methods so far devised, to furnish a measure of psychical work in physical terms. A series of papers on the subject by these authors has appeared in the *Année psychologique*, the first in the issue for 1895, and four others in the last volume.[2] In approaching the question it was first of all necessary to study the effect of changes in respiration on the heart beat and blood supply. A large part of the first paper is accordingly taken up with this and with an examination of possible errors in the apparatus. The instrument used was the plethysmograph of Hallion and Conte. This consists of a rubber cylinder, which is grasped firmly by the hand. The outer surface of the hand is covered with a tight-fitting glove, so that any expansion in volume of the hand (due to increased blood pressure) takes effect on the inner surface, and results in diminishing the volume of the rubber cylinder; the latter communicates by means of a tube with a flexible drum. When the cylinder is compressed by the hand the drum rises, and the effect is recorded by means of a pen attached to the drum. The apparatus was found to be very serviceable, and was remarkably free from error. In addition to the frequency and strength of the pulse beat, the dicrotism, or break in the beat, was clearly marked in the diagrams, and proved an important factor in the results.

[2] Vol. III, 1896, published this spring.

MM. Binet and Courtier note the existence of important individual differences in the effects of mental work on the physical processes. In some subjects these are confined almost wholly to changes in the respiration, in others to the action of the heart, while in others they are felt more especially in the vaso-motor system. In general, the effect on the respiration is to make it more rapid and at the same time more superficial. The effects on the pulse curve most frequently observed are: 1st, diminution of amplitude; 2d, diminution of amplitude with change of form; 3d, diminution of amplitude, change of form and lowering of the level of the curve. One or other of these effects appear in almost all the subjects tested.

In their later papers the authors consider in turn the various causes of change in the pulse. They confirm the well-known diurnal changes by numerous observations with their own method, e. g., that the pulse becomes more frequent and the dicrotism generally more marked immediately after a meal. As regards physicial exercise, they lay special stress on the changes that occur in the dicrotism according as the exercise is local, general and moderate, or general and fatiguing.

The study of the effects of mental work is, of course, the most important from the psychological standpoint, and here the authors have sought to combine tests of the heart and respiration with those of the pulse. In addition to the more delicate tests, involving simple mental operations, two of the subjects undertook a piece of severe and prolonged mental work; they spent seven hours working steadily at this task, merely resting at the end of each hour for a time sufficient to perform the necessary tests. Comparing the results with those of a similar period passed under similar conditions but without work, the pulse was found to be considerably retarded in the former case, as compared with the latter, the retardation taking place especially in the early part of the period. The authors sum up their results on mental work as follows: "1. An energetic, but short mental effort produces an excitation of function, vaso-constriction, acceleration of the heart and of the respiration, followed by a very slight retarding of these functions; in some of the subjects a blunting of the dicrotism. 2. Intellectual work lasting for several hours with comparative immobility of the body produces a retardation of the heart and a diminution of the peripheral capillary circulation."

As regards the relation between physical and mental work, the authors are cautious in drawing conclusions. They observe a certain parallelism, in that a single energetic effort produces an acceleration of the heart and lungs, while a long-continued and fatiguing effort frequently weakens the dicrotism. On the other hand, the excitation of the heart is more marked and the acceleration of the respiration greater in physical than in mental work; again, in physical work the respiration grows deeper, while in mental work it becomes more superficial; and finally, prolonged mental work tends to produce a weakening of the peripheral circulation, an effect not observed in the experiments on physical work.

The effects of *emotion* on the heart and pulse are the topic of the last paper by the same authors. The experiments on this difficult problem were contrived with considerable ingenuity. Some of the subjects were children of from 8 to 10, in whom it was easy to excite fear, surprise, pleasure, etc. With adults the tests had to be more carefully planned; a false alarm of fire was prearranged in one case, and resulted in real fear on the part of the subject; another subject after being blind-folded had his hand placed on a pile of worms. A number of tests embodying various emotions were successfully made. It was found that every emotion tended to weaken the pulse; the quality of the emotion, whether pleasurable or painful, had no marked influence—the contrast was altogether between a state of mental rest and one of emotional disturbance. The heart showed a tendency to accelerate when the excitement was strong, and here too no difference was observable between the pleasant and the painful. The influence on the respiration was most marked of all; every emotional excitement produced an acceleration, and at the same time an increase in depth and a shortening of the pause.

The authors added a special study of the effects of music on these functions. Their experiments on this point were confined to one person—a man of fine musical appreciation and with considerable of a musical education; they represent, therefore, merely a single type of individual. There was found to be a distinct, though slight quickening of the respiration and heart in consequence of hearing the tones themselves, and apart from any emotional "echo" aroused by them. When a melody was played, whether sad or gay, the acceleration was more marked, and it reached a climax when the piece was of a dramatic character and particularly fitted to arouse emotion. This acceleration, however, was not accompanied by any noticeable irregularity. There was at the same time in general a weakening of the capillary circulation, which was less when the sounds had merely a sensorial effect than when they produced a distinct emotional disturbance.

In summing up the whole question of emotional effects on the bodily functions, the authors again lay stress on the differences among individuals. From their own observations they are inclined to distinguish three separate classes of effects. 1. In a majority of persons every emotion produces a vascular constriction, an acceleration of the heart and of the respiration, and an increase of amplitude in the thoracic cavity. 2. In some few cases a sensation of pain or an emotion of sorrow may produce a slight retardation of the heart; and 3. It is possible, as observations made on one subject prove, that the form of the capillary pulse may change with the quality of the emotion; this last effect, they remark, may in time enable us to make a classification of the emotions according to their physiological effects on the form of the pulse.—H. C. W.

ANTHROPOLOGY.[1]

Observations on the Scapulæ of Northwest Coast Indians.—Researches on the scapula since the time of Broca's[2] paper in 1878 have not been very numerous or conclusive in their results, and it seems fair to say that the valuable ethnic results which it was expected would be derived from extended observations on the scapula have not proved entirely satisfactory. Nor does it yet seem possible to say whether this is due to the insufficient numbers of scapulæ which have been examined or to individual variation. From an examination of the literature on the subject, especially from the papers of Sir William Turner[3] and Professor Dwight,[4] one would infer that the latter reason is the chief cause for the unsatisfactory results. Indeed, Professor Dwight declares,[5] "I do not know what range of variation a great series of the scapulæ of the larger felidæ might present, but a small one shows nothing like that of the human race—I might even add, that of the Caucasian." It must be confessed, however, that the numbers of observations so far made have been exceedingly small. This is to be explained, of course,

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[1] This department is edited by H. C. Mercer, University of Pennsylvania.

[2] "Sur les indices de largeur de l'omoplate chey l'homme," etc., Bull. de la Soc. d'anthropologie de Paris, Feby. 21, 1878.

[3] Challenger report, Zoology, Vol. XVI, "Report on the Human Skeletons," p. 81.

[4] "The Range of Variation of the Human Shoulder-blade," AMERICAN NATURALIST, July, 1887.

[5] "The Range and Significance of Variation in the Human Skeleton," Boston, 1894, p. 23.